New data – old theories: the future of theorizing about innovation in complex adaptive systems

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If we by *innovation* mean generally how complex adaptive systems maintain and renew their structures and processes, understanding innovation becomes an issue of high generality and importance. It comes to concern the very core of the question of how a wide, important but poorly understood class of systems can be understood at a fundamental level.

The past two-three decades have seen an accelerating technology-driven development of techniques for empirical data gathering, analysis and storage. This has led to a dramatically improved empirical picture in all the three "innovation fields" that we deal with at this workshop – archaeology, biology and innovation studies in the social sciences and humanities.

An often-heard question today is: what do we do with all this new data? The basis for the framing of this workshop is that we have data that is new in both a quantitative *and* a qualitative sense – and we focus particularly on its novelty in the latter of these senses. Entirely *new things* have become possible to study empirically[1].

These developments obviously bring with them substantial potential for advancing our understanding of innovation in complex adaptive systems. But a lot of this potential hides behind steep challenges, many of which remain to be discovered, and it may bring the need for fundamental theoretical and methodological work. These potentials and challenges need to be properly identified. In this workshop we deal with what we think is an important aspect of this question: *that of how "new data interacts with old theory", and, what might appear out of this area of friction*.

To provide a framing, that one can agree or disagree with, and that in any event is only one of the stories that can be told about what has happened, let us begin from one observation: Old and cherished theories, models and received views have found themselves under substantial pressure in these new empirical contexts. Theory developed in earlier and more "data sparse" eras – and that is adapted to such conditions – has in many cases proven not to only be unable to accommodate these new empirical pictures; it has also been discredited by them. In fact, this development is importantly impacting our notions of what terms like novelty and innovation mean. In biology, novelty used to be equated with genetic mutations and in the social sciences novelty was basically invention while innovation was a subsequent process of spread an adoption.

We note in particular the following difference between then and now with regard to innovation: *we can today study the mechanisms of innovation in much more detail*.

Older theory tends to black-box the mechanisms that are at play in the studied system – in other words they attempt to make do without data that used to be hard or impossible to obtain. Older theory also imposes strict scale separations, which allowed theory construction to be focused on

[1] In biology and archaeology we see in particular the addition of a whole battery of laboratory techniques (e.g. DNA analysis and improved dating methods to mention a few). In the social sciences, ICT has made data more voluminous, accessible and amenable to automatic analysis, it has allowed more systematic and microscopic data gathering possible, and it has also greatly facilitated literature searches.

quite separate subsystems, typically on a privileged level of organization. This led to theory that was workable under the technological and empirical conditions that existed, and that moreover shaped the very notion of what proper science really ought to be.

Today we see these black boxes coming ajar, and we see the interfaces between those separated subsystems – by now often marking the separation between entire disciplines – coming into view. This reveals that many basic theoretical assumptions were misguided in highly consequential ways.

So where do we go from here? In previous workshops we have nurtured the idea of combining experiences and lesson between fields in recognition of the fact that it seems like innovation in this new empirical picture operates according to similar principles across these disciplines (and surely other disciplines as well). This will be our prejudice here as well although of course one that is open for discussion.

Some topics (not entirely orthogonal) for this workshop in bullet form:

(i) What is novelty and innovation?
(ii) Discuss the nature of the friction between "new data and old theories"
(iii) Constructively discuss how new data could drive theory development in these fields
(iv) What do we need from new theory? What do we sense that such theory could answer?
(v) In such a theoretical transition, what is the role of "old theories"? Revolution, reformation or something in between?
(vi) Methodological questions concerning the use of new data.
(vii) Discuss the difference between how these systems used to be viewed and the new emerging picture?
(viii) What new sorts of insights may become accessible?
(ix) Where applicable, what are the implications for policy?
(x) How does all of this reflect on a general view of innovation in complex adaptive systems?
(xi) How does it reflect on our view of complex systems in general?